New England Plant Conservation Program

Platanthera ciliaris (L.) Lindl.
Yellow-fringed orchis

Conservation and Research Plan for New England

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SUMMARY

Platanthera ciliaris (L.) Lindl., yellow-fringed orchis (Orchidaceae), is a perennial terrestrial herb typically found in open to lightly wooded moist habitats with acid to sub-acid soils. It is a globally secure species (G5) and in the United States is ranked as N5 (Nationally Secure) as of February, 2002. Prior to that time, it was N?, or status uncertain. In Canada, where it is known only from Ontario, *P. ciliaris* is ranked NX and is considered extirpated. Once more widespread in southern New England, it now occurs in only ten extant populations, all situated within thirty miles of the coastline. The *Flora Conservanda:* New England identifies *P. ciliaris* as a Division 2 or regionally rare species "with fewer than 20 occurrences documented since 1970."

Platanthera ciliaris ranges from southern New England west to southern Ontario (historic), southern Michigan, Illinois south along the coastal plain to Florida, and west to Texas, Oklahoma and Missouri. In the heart of its range, it is tolerant of a wide variety of habitats including wet peaty meadows, marshes, prairies, pine savannas, sandy, open woods, moist sand flats, damp swales and slopes, dry wooded slopes, acid swamps, and sphagnum bogs. It will also grow at disturbed sites such as road shoulders, logging trails, power line clearings, and railways. At the northern limits of its range in New England, *P. ciliaris* is less tolerant with respect to habitat preference and the extant populations are found in moist, sunny, open areas. Natural succession and competition from woody vegetation appear to be principal causes for the recent disappearance of several populations and the apparent declines of some extant populations.

Fruit set for *Platanthera ciliaris* is dependent upon successful pollination and the flower structure and color are adapted to attract visually oriented visitors. The primary pollinators for this species are butterflies, particularly swallowtails (*Papilio* spp.). There is a positive correlation between open habitats and the numbers of flowers pollinated. Thus, maintaining open habitats to encourage pollinator access may be critical to sustaining healthy populations of the species. Soil fungi (mycorrhizae) are essential for the development and growth of *P. ciliaris*. The taxon is potentially vulnerable to threats posed by shading, habitat change, collection, herbivory trampling, and late spring frost.

The primary conservation objectives in New England for *Platanthera ciliaris* are to restore vigor to all of the extant Connecticut populations and one Rhode Island population and to maintain a minimum of fourteen occurrences with no fewer than 50 to 250 individuals occurring at each site. Searches should be conducted at locations near extant or historic populations and in sites with seasonally saturated, sandy, acidic soils with open or semi-open canopies in and near towns from which there are records. Management strategies have been initiated at the Rhode Island occurrences and at one of the Connecticut sites. The treatments may serve to guide management actions at other sites. Site-specific management plans aimed at reinvigorating and maintaining the existing populations should be developed and implemented for each of the extant populations.

PREFACE

This document is an excerpt of a New England Plant Conservation Program (NEPCoP) Conservation and Research Plan. Full plans with complete and sensitive information are made available to conservation organizations, government agencies, and individuals with responsibility for rare plant conservation. This excerpt contains general information on the species biology, ecology, and distribution of rare plant species in New England.

The New England Plant Conservation Program (NEPCoP) of the New England Wild Flower Society is a voluntary association of private organizations and government agencies in each of the six states of New England, interested in working together to protect from extirpation, and promote the recovery of the endangered flora of the region.

In 1996, NEPCoP published "*Flora Conservanda*: New England." which listed the plants in need of conservation in the region. NEPCoP regional plant Conservation Plans recommend actions that should lead to the conservation of *Flora Conservanda* species. These recommendations derive from a voluntary collaboration of planning partners, and their implementation is contingent on the commitment of federal, state, local, and private conservation organizations.

NEPCoP Conservation Plans do not necessarily represent the official position or approval of all state task forces or NEPCoP member organizations; they do, however, represent a consensus of NEPCoP's Regional Advisory Council. NEPCoP Conservation Plans are subject to modification as dictated by new findings, changes in species status, and the accomplishment of conservation actions.

Completion of the NEPCoP Conservation and Research Plans was made possible by generous funding from an anonymous source, and data were provided by state Natural Heritage Programs. NEPCoP gratefully acknowledges the permission and cooperation of many private and public landowners who granted access to their land for plant monitoring and data collection.

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I. BACKGROUND

INTRODUCTION

Platanthera ciliaris (L.) Lindl., yellow-fringed orchis, is a perennial member of the orchid family (Orchidaceae). It is a striking plant with an inflorescence of numerous brilliant orange flowers. Primarily a plant of open, sunny, moist habitats, *P. ciliaris* will also tolerate light shade and dry conditions. In the heart of its range, Kentucky and North Carolina, *P. ciliaris* is tolerant even of shady, densely forested habitats; however, that does not appear to be the case in New England. This orchid shows a strong preference for acid to sub-acid soils with little to moderate amounts of organic material present. In New England, it grows at the northern limits of its range and is restricted to areas of "preferred" habitat. These open habitats will need to be actively managed in order to ensure that the species will persist in the region.

Platanthera ciliaris is regarded as Globally Secure (G5) and has a national rank of N5 (Nationally Secure) in the United States and NX (Extirpated) in Canada. It is listed as rare (S1 or S2) in 12 of the 29 states from which it is reported. In 4 of the 29 states, it is ranked either SX, Extirpated or SH, Historic. In Ontario, it is considered extirpated. In New England, *P. ciliaris* was once more widespread, and forty-one occurrences are included within the databases of the southern New England states. The taxon is currently known from only ten sites in New England: eight sites in Connecticut (where it is ranked S1 by NatureServe (2003) and S2 by *Flora Conservanda* (Brumback and Mehrhoff et al. 1996) and is state-listed as Threatened); and two populations in Rhode Island (where it is ranked S1 and state-listed as Endangered). It should be noted that *P. ciliaris* has not been observed in recent years at five of the eight extant Connecticut sites and one of the two extant Rhode Island sites. No sites remain in Massachusetts, where *P. ciliaris* is ranked SX, Extirpated. The *Flora Conservanda:* New England identifies *P. ciliaris* as a Division 2 or regionally rare species "with fewer than 20 occurrences seen since 1970" (Brumback and Mehrhoff et al. 1996).

The showy flowers of *Platanthera ciliaris* draw many admirers and one threat to its survival is collecting and picking. On February 13, 2003, *Platanthera ciliaris* was listed in Appendix II of the Convention on International Trade in Endangered Species (CITES) along with other orchid species, presumably because of concern that orchids were being over-collected from the wild (UNEP-WCMC 2003).

This conservation and research plan summarizes known information regarding the biology and ecology of *Platanthera ciliaris* and identifies the threats to its continued survival. The plan also recommends actions that will promote the conservation and recovery of the species in New England. These actions, which include but are not limited to active habitat management, searches at historical, recently lost, and new sites, annual monitoring, and assessments of threats, are designed to achieve the following overall conservation objective: to protect and maintain fourteen populations, each with a minimum 50 to 250 stems, in southern New England.

DESCRIPTION

The following description of *Platanthera ciliaris* is based upon a compilation of morphological characteristics taken from the following references: Correll (1950), Fernald (1950), Gleason (1968), Luer (1975), Case (1987), Gleason and Cronquist (1991), Homoya (1991), and Brown (1997).

Platanthera ciliaris is a showy, charismatic, perennial orchid that ranges in height from 24 to 100 cm and is glabrous throughout. It is characterized by an upright stem having from two to four large, spreading lower leaves and abruptly reduced upper leaves that resemble bracts. The lower leaves sheath the stem and are lanceolate to lance-elliptic. They vary from 5 to 40 cm in length and 0.6 to 6 cm in width. Upward on the stem, the bract-like leaves dwindle and merge into the raceme as floral bracts. The stem arises from one or two fleshy thickened oval roots or tuberoids. The tuberoids are up to 4 cm long and 1.5 cm in diameter. In addition to the tuberoids, there are numerous fleshy, tuberous and tapering roots. The inflorescence is cylindrical and often compact, ranging from 3.5 to 20 cm in length and 4 to 8 cm in width. The inflorescence comprises from 25 to as many as 115 brilliant deep yellow to orange resupinate (upside down due to twisting of pedicels) flowers. In Illinois, Sheviak (1974) observed a colony that included plants with normal flowers in addition to plants with flowers of an unusual, non-resupinate form. The dorsal sepal is entire or rarely notched at the apex. Sepals are broadly oval to obovate, 5 to 8 mm, the lateral ones reflexed or spreading. Lateral petals are linear-oblong and concealed under the sepals. The petals are 4 to 5 mm long and 1 to 1.5 mm wide with apically fringed margins. The lip extends forward and slightly downward and is oblong to broadly ovate-spatulate and delicately long-fringed. The lip is often compoundly fringed and can measure up to 1 cm in length, with the fringed margin adding another cm. The slender cylindric nectar spur, directed downwards and back, is 20 to 25 mm in length. The ovary is pedicellate, slender and orange, 20 mm long. The column is 3 by 3 mm with 2 opposite anther cells and 2 yellow pollinia on a long stipe. The ellipsoid capsule measures 20 by 4 mm. The flowers open progressively from the bottom of the inflorescence to the top.

The only other cogener in the northeast with similar color to *Platanthera ciliaris* is *P. cristata*; however, the latter is a smaller orchid, rarely exceeding 20 cm in height. The flower raceme of *P. cristata* is smaller and more compact than that of *P. ciliaris* (Gupton and Swope 1986). The flowers of the two species differ in that those of *P. cristata* are smaller and a deeper, richer orange (Keenan 1998). In *P. cristata*, the lateral petals are rounded and fringed along the entire margin, whereas lateral petals of *P. ciliaris* are slender and only slightly fringed along the tip (Gupton and Swope 1986, Keenan 1998).

Platanthera ciliaris closely resembles *P. blephariglottis*, but the two are readily told apart in the field by the color of their flowers. The brilliant orange of *P. ciliaris* contrasts sharply with the pure white flowers of *P. blephariglottis*. Herbarium specimens of the two are more difficult to distinguish; however, in *P. blephariglottis* the fringes on

the lip are coarse and extend out around the entire lip margin, whereas in *P. ciliaris*, the fringes are slender and delicate and hang parallel to the limb of the lip (Luer 1975).

The orange-flowered *Platanthera chapmannii* is also similar in appearance and was once thought to be a hybrid between *P. ciliaris* and *P. cristata*. *Platanthera chapmanni* is now considered as a separate species and its range is limited to southern states (Cingel 2001).

TAXONOMIC RELATIONSHIPS, HISTORY, AND SYNONYMY

Platanthera ciliaris, the yellow or orange-fringed orchis, is a member of the orchid family (Orchidaceae). The genus name is derived from the Greek *platys* meaning "broad" and *anthera*, "anther." "*Ciliaris*" comes from the Latin "*cilium*" for eyelid or eyelashes and refers to the finely fringed lip. The taxon has been known to botanists since 1704 and was given its specific name by Linnaeus in 1753 (Luer 1975). The genus *Platanthera* was first described in 1818 by the French botanist Louis Claude Marie Richard (Luer 1975). Richard wished to separate *Platanthera* from *Orchis* and *Habenaria* and did so because of the broad anther shared by *Platanthera* species. Today, the genus *Platanthera* contains around 200 species, which grow in the temperate regions of both hemispheres (Luer 1975).

Platanthera ciliaris is placed in the sub-family Orchidoidae, the tribe Orchideae and the sub-tribe Orchidinae (Dressler 1998). Members of the sub-tribe are primarily plants of the northern hemisphere. They are terrestrial, usually with root-stem tuberoids and slender stems. Leaves are spiral or basal, soft herbaceous, and the inflorescence terminal (Dressler 1998). There are 34 genera within Orchidinae in 4 tentative alliances and *Platanthera* is included in the group with palmate or attenuate tubers (Dressler 1998). According to Dressler (1998), there is a need for a review of the entire group and the distinction between Orchidinae and Habenariinae needs to be re-evaluated.

Synonymy includes the basionym (the name in which the accepted specific epithet first appeared) *Orchis ciliaris* Linnaeus, Sp. Pl. 2: 939. 1753; *Habenaria ciliaris* (Linnaeus) R. Brown in Aiton Hort. Kew. Ed. 2. 5: 194. 1813.; *Blephariglottis flaviflora* Rafinesque, Fl. Tellur. 2: 38. 1836; and *Blephariglottis ciliaris* (Linnaeus) Rydberg in Britton, Man. 296. 1901 (Luer 1975, Flora of North America Committee 2002).

Where *Platanthera* species grow together, hybrids often occur. In some cases, the hybrids will outnumber the parent forms (Case 1987). When this occurs, many variations may be present, including buff or lemon-colored flowers or flowers with orange sepals and petals and white lips (Case 1987). The hybrid of *Platanthera ciliaris* with *P. blephariglottis* is *P.* × *bicolor* (Rafinesque) Luer and the hybrid of *P. ciliaris* with *P. cristata* is *P.* × *channellii* Folsom. In New England at RI .006 (Charlestown), Irene Stuckey noted plants with cream-colored flowers, which she surmised to be *Platanthera ciliaris* and *P. blephariglottis* hybrids (Rhode Island Element Occurrence Record [EOR] for *Platanthera ciliaris,* EO .006).

SPECIES BIOLOGY

Platanthera ciliaris is an herbaceous perennial that, in New England, flowers in July and August (Magee and Ahles 1999; Sharp, personal observation). As is true for other species of the genus, *P. ciliaris* has thick, fleshy roots that support its upright stem. Each year, a bud is produced on one of the roots that will give rise to the next year's plant (Case 1987). The bud develops new roots and tuberoids. At the end of the growing season, the primary plant withers leaving the new bud and its tubers to propagate next year's plant. If the primary plant becomes damaged, next year's plant is likely to be reduced in size and vigor (Case 1987). The growth of orchids in the spring arises from the over-wintered buds (Sheviak 1990). A late frost, animal damage, disease, or other calamity at the onset of the growing season can be devastating to *P. ciliaris* as it, like other orchids, is unable to replace the lost tissue until the following year (Sheviak 1990). In fact, Sheviak (1990) found through his monitoring studies that shoot loss before and during bloom of *P. ciliaris* resulted in the death of the plant.

As a typical orchid flower, the filaments, anthers, style, and stigma of *P. ciliaris* are reduced in number and fused into a structure known as the column. The stigmatic surface includes two of the three stigmas. The third stigma is sterile and forms a slender extension from the upper edge of the stigmatic surface. This sticky structure is called the rostellum. The rostellum serves to attach pollen to insects, which aids in the transport of pollen from one flower to another. Pollen grains form soft little packets that bind together by viscin threads (Pijl and Dodson 1966). These pollen masses are referred to as pollinia. The labellum, or lip, is a specialized petal that is technically uppermost, but becomes the lowermost petal by the twisting of the pedicel.

In *Platanthera ciliaris,* the fringed labellum serves as a landing platform for pollinators and is an adaptation that attracts visually oriented visitors. The long, down-turned spur contains the flower nectar. This long and narrow nectary is suited for pollination by long-tongued insects such as bees, butterflies or moths. The complicated floral structure of *P. ciliaris* encourages cross-pollination by insects. The insect lands on the lip, probes for nectar, and inadvertently collects the pollen on its back in the process of retreating from the flower. According to Case (1987), some species of *Platanthera* appear to be self-pollinating and it is not known whether these species are wholly self-pollinating or if some cross-pollination occurs. Robertson and Wyatt (1990), state that *P. ciliaris* is self-compatible but not autogamous. In their study, flowering plants that had been caged to prevent pollinator access failed to set fruits. The fact that *P. ciliaris* sometimes hybridizes with *P. blephariglottis* indicates that it is cross-pollinated. In a study of the pollination ecology of *P. ciliaris* and *P. blephariglottis*, Smith and Snow (1976) report that *P. ciliaris* is pollinated during daylight hours primarily by butterflies and that *P. blephariglottis* is pollinated at night by moths. In this pollination study, Smith and Snow (1976) observed that the number of *P. ciliaris* flowers pollinated from open habitats was approximately double the number pollinated from semi-shaded habitats. The researchers attribute this to the fact that *P. ciliaris* is largely pollinated by day-flying butterflies, which are initially attracted by the brightly colored flowers. Thus,

maintaining open habitats to encourage pollinator access may be critical to sustaining healthy populations of this orchid. The principle pollinator butterfly for *P. ciliaris* in the Smith and Snow study was *Papilio troilus*, the spicebush swallowtail. Other butterflies observed to be carrying pollen included the tiger swallowtail (*P. glaucus*), striped hairstreak (*Strymon liparops*), and the monarch (*Danaus plexippus*). The Ruby-throated Hummingbird (*Archilocus colubris*) and the white-lined sphinx (*Hyles lineata*) were also seen visiting the flowers (Smith and Snow 1976). Eleanor Saulys (Consulting Botanist, personal communication) has observed black swallowtails and a small dark beetle leaving *P. ciliaris* with pollinia on their backs. At CT .002 (East Lyme) and CT .006 (Deep River) spicebush swallowtails were observed actively feeding on *P. ciliaris* nectar (Sexton undated). Once pollinated, the orchid flower begins to wither and the seed capsule forms and ripens. Seed set for *P. ciliaris* in New England is usually completed by late August (Sexton undated).

In their research on the reproductive biology of *Platanthera ciliaris*, Robertson and Wyatt (1990) found that fruit set is pollinator-limited. Hand-pollination produced higher levels of fruit set than were found in the natural levels in the populations that they studied. Another interesting finding stemmed from a comparison of mountainous populations to coastal plain populations of *P. ciliaris* (Cingel 2001). In the mountains, *Papilio troilus* was the most prevalent pollinator, whereas in the coastal plain, *Papilio palamedes* (Palamedes swallowtail) was prevalent and *P. troilus* a rare pollinator. The spur lengths of *P. ciliaris* mountain populations were shorter on average by ±2 mm than spurs of the coastal plain individuals. Interestingly, the proboscis of *Papilio trolius* is shorter than that of *P. palamedes* and higher fruit set was noted in the mountain populations (Cingel 2001). Pollination ecotypes of *P. ciliaris* may be a result of the selection pressure exerted by the proboscis length of the pollinator butterflies.

Platanthera ciliaris produces copious amounts of tiny, dust-like seeds that become widely dispersed by wind or water (Case 1987). Although dispersal may be far-reaching, these ultra-light seeds are completely lacking in food reserves. Therefore, it is imperative that the seeds reach a hospitable environment that contains essential mycorrhizae for germination. Mycorrhizal fungi play an important role in seed germination, and appear to be indispensable to orchid growth throughout the life of the plant (Smith 1966). The relationship between an orchid and its mycorrhizal partner(s) is complex and poorly understood, although the ability of a given soil to support orchid growth depends upon the presence of certain soil fungi. For this reason, the ecology of *P. ciliaris* is also the ecology of its mycorrhizal relationships. Research and experimental investigations regarding these relationships would be useful in increasing an understanding of soil requirements and, consequently, bettering the management of *P. ciliaris* populations. The early growth of orchids is slow and there is a lengthy lapse of time before *Platanthera* seedlings become self-supporting by carrying on photosynthesis (Smith 1966). Case (1987) found large numbers of *P. ciliaris* seedlings in Michigan sphagnum bogs. Seedlings with tubers less than 1 to 2 cm long remain underground in the dead brown sphagnum below the living layers of the moss. They appear as tiny, white, spindle-shaped tissue masses and larger seedlings may have a leaf or stem bud present (Case 1987). During this underground phase, which may persist for several

years, mycorrhizal fungi are directly involved in seedling nutrition and serve to break down complex carbohydrates (Smith 1966). Once the seedling emerges and is above ground, the mycorrhizal relationship may become symbiotic (Smith 1966, Hadley 1970). Fungi infecting orchid seeds are often different from the fungi that infect the roots; however, the common species of orchid fungi belong to the genus *Rhizoctonia*. As previously indicated, these mycorrhizal relationships are not well understood; however, they are delicately balanced and are at risk from disturbance (Sheviak 1990). This factor must be considered in the management of orchid populations.

Platanthera species, including *P. ciliaris*, may be vulnerable to fungal attack. The disease-causing fungus manifests itself by a blackening of the orchid leaves. If colonies become seriously infested with this blackening disease, the orchids may disappear entirely (Case 1987).

Herbivory has been documented at some populations of *Platanthera ciliaris*. In Rhode Island, Stuckey (1967) reports that rabbits and deer eat orchids and documents the predation of *Platanthera blephariglottis* by rabbits. At RI .014 (Charlestown), deer have been known to eat some of the *P. ciliaris* flowers (Rick Enser, Rhode Island Natural Heritage Program, personal communication). At CT .007, flower heads of two of the three flowering plants were completely bitten off in 1996 and at CT .002, one of the six fertile plants appeared to have been consumed (William Moorhead, Consulting Botanist, personal communication). Case (1987) reports that rodents consume the tender buds and fleshy tuberoids of *P. ciliaris.*

HABITAT/ECOLOGY

Habitats for *Platanthera ciliaris* include moist sandy and peaty meadows, marshes, prairies, pine savannas, sandy, open woods, moist sand flats, damp swales and slopes, roadsides, dry wooded slopes, acid swamps, and sphagnum bogs (Fernald 1950, Gleason 1968, Gleason and Cronquist 1991, Homoya 1991, Crow and Hellquist 2000, Flora of North America Committee 2002). Morris and Eames (1929) state that ditches along railways are favorite haunts of *P. ciliaris* and the growth of the plant may have been fostered by the frequent fires that occurred historically along rail lines. Many researchers mention the fact that *P. ciliaris* often grows in disturbed areas such as power line cuts, roadsides, ditches, and gravel pits. For the most part, it is absent from deeply shaded habitats, thus the maintenance of populations requires periodic disturbances such as fire, mowing, or clearing to suppress competing vegetation. Its primary requisites for optimum growth seem to be open sunny locations, moist, acidic soils, and pollinator-access to flowers.

Habitat in New England

In New England, *Platanthera ciliaris* is at the northern limits of its range, one factor that may account for its scarcity (Dowhan and Craig 1976). Although suitable

habitat is available throughout much of New England, its failure to colonize such areas is characteristic of the habitat selection and conservative reproduction seen in other species on the edges of their ranges (Homoya 1991). The extant populations of *P. ciliaris* are confined to open, sunny habitats, all of which contain acidic moist soils. In a study of Rhode Island populations, Stuckey (1967) found that the pH levels in soils were as follows: at 0-2 inches depth (0-5 cm), pH = 4.1 to 4.7; at 2-4 inches depth (5-10 cm), pH = 4.3 to 4.8; and at 4-6 inches depth (10-15 cm), pH = 4.4 to 4.8. None of the soils examined contained more than 20 pounds of available phosphorus per acre and most had low levels of available potassium (Stuckey 1967). High levels of potassium were found within areas that had recently been burned; however, it was not apparent whether the positive effects of burning included the release of potassium or other nutrients.

In this region, *P. ciliaris* is considered to be FACW or a Facultative Wetland species, with an estimated 67%-99% probability of occurrence in wetlands (Department of the Army, U. S. Army Corps of Engineers 1987). Once found in greater numbers (41 reported populations in New England), only ten extant sites remain. Of these ten, six have not been seen in recent years. Seven populations have disappeared within the past 35 years, primarily due to plant succession and shading by woody growth. These sites are: RI .001 (Burrillville); RI .002 (Hopkinton); RI .004 (Kingston); RI .005 (South Kingstown); RI .006 (Charlestown); CT .003 (Chester); and CT .005 (Old Saybrook). The status of several populations that have not been seen in recent years, including CT .004 (Voluntown), and CT .007 (Old Saybrook), and CT .011 (Montville) is unknown and probably precarious.

RI .014 (Charlestown) is New England's "hot spot" for this species, with well over 20,000 individual plants present. The plant community is best described as a maritime grassland/shrubland community, although the area has been subject to disturbance (Killingbeck et al. 1998). In addition to *Platanthera ciliaris,* six other species that are considered to be rare in Rhode Island occur at the site (Killingbeck et al. 1998). At RI .014 (Charlestown), associated species include: *Rhynchospora capitellata; R. fusca, Aletris farinosa; Xyris torta; Osmunda cinnamomea; Drosera rotundifolia; D. intermedia; Juncus effusus; Spiranthes vernalis; Scleria triglomerata; Scleria pauciflora; Cladium mariscoides; Polygala cruciata; Pteridium aquilinum; Clethra alnifolia; Vaccinium* sp.*; Myrica pensylvanica,; Amelanchier canadensis; Acer rubrum;* and *Eupatorium maculatum* (Sharp, personal observation).

New England's second largest site is CT .002 (East Lyme), where the all-time high count in 1990 was over 17,000 individual plants (Sexton 1991). More recent counts have been in the range of 50 to 100 flowering individuals (Saulys, personal communication). The site falls within the Southeast Hills Ecoregion of Connecticut, a near-coastal upland lying within 30 miles of eastern Long Island Sound and characterized by low, rolling hills, and moderately broad and level upland and valley bottoms (Dowhan and Craig 1976). The habitat for this population is best described as a wet meadow. It has been maintained as such by periodic mowings, although it appears that mowings have become less frequent in recent years (Saulys and Sharp, personal observations). The site is underlain by Woodbridge very stony fine sandy loam soils that have a seasonally high

water table (Crouch 1983). The area comprises about an acre in size and was cleared of all trees in 1965 for agricultural use. The site proved too wet in the spring for cultivation, but has been mowed periodically since that time. It was mowed with greater frequency during the peak years of this population. Associated species at CT .002 (East Lyme) include: *Acer rubrum; Populus grandidentata; Liriodendron tulipifera; Spiraea tomentosa; S. latifolia; Salix* sp.*; Thelypteris noveboracensis; Toxicodendron radicans; Eupatorium maculatum; Eleagnus umbellata; Juncus effusus; Myrica pensylvanica; Vaccinium* sp.*; Solidago* spp.*; Osmunda cinnamomea;* and *Sassafras albidum* (Sexton undated).

Another Connecticut site, CT .006 (Deep River), also occurs within the Southeast Hills Ecoregion. The population grows within a low, seasonally wet meadow habitat that is maintained by annual fall mowings. Underlying soils are Walpole sandy loams that have a seasonally high water table (Reynolds 1979). The area surrounding the population is kept as a lawn and is mowed continuously throughout the growing season. Recently, the property management has been asked to permit an expansion of the annually mowed area and this has resulted in an increase of non-flowering individuals of *Platanthera ciliaris*. Members of the Connecticut Botanical Society are monitoring this population. Associated species at this site include: *Prunus pensylvanica* (Seedlings)*; Rubus hispidus; Vaccinium corymbosum; V. macrocarpon; Myrica pensylvanica; Bartonia virginica; Xyris torta; Ionactis linariifolius; Schizachyrium scoparium; Solidago bicolor;* and *S. rugosa* (Sharp, personal observation).

A third extant Connecticut population, CT .009 (Montville), grows in a low spot adjacent to a road. Like the two other extant sites, it is situated within the Southeast Hills Ecoregion of Connecticut (Dowhan and Craig 1976). Soils are the poorly drained Ridgebury, Leicester and Whitman complex, which has a seasonally high water table. These soils are slow to warm up and dry out in the spring (Crouch 1983). Associated species at this site include: *Acer rubrum; Symplocarpus foetidus, Betula alleghaniensis; Clethra alnifolia; Osmunda cinnamomea;* and *Melampyrum lineare* (data from Connecticut EORs).

Habitat Elsewhere in Platanthera ciliaris *Range*

In the United States, *Platanthera ciliaris* is mostly confined to states east of the Mississippi, although it is reported in Texas and Oklahoma. The taxon is widespread and apparently secure in North Carolina, where it occurs in a wide range of habitats, including upland forests. According to Keenan (1998: 185), it reaches its greatest abundance in the Cumberland Mountains of Kentucky, where it is found "invading practically any type of strongly acid open habitat, especially above 2000 feet (600 m) in wet or disturbed sites along road shoulders, logging trails, power line clearings and second growth pine thickets." Although most botanists regard *P. ciliaris* as a plant of sunny open places, in the Blue Ridge of North Carolina, it grows in deep shade (Case 1987). In the southern United States, it may also occur on rocky, well-drained open ridges and grassy fields, usually in strongly acid soils. It occurs at elevations near sea

level along the coastal plain, up to 1,600 feet (480 m) in Georgia, 2,000 (600 m) feet in Alabama, and 5,500 feet (1,650 m) in the mountains of North Carolina and Tennessee (Correll 1950).

According to Case (1987), *Platanthera ciliaris* occupies a variety of habitats, tolerates acid soils, and does not appear to require any particular moisture conditions. However, in Michigan, the plant occurs only in tamarack-sphagnum bogs or open, damp, sandy meadows or marsh borders with low acidity. Correll (1950) also indicates the wide tolerance of *P. ciliaris,* noting that it appears in almost any type of habitat, being found in sphagnum and sedge bogs, swamps, marshes, thickets, borders of streams and ponds, in low woods, pine barrens, wet meadows, savannahs, prairies, and in deep humus of upland pine and hardwood forests and in seepage of swampy wooded slopes. In Indiana, *P. ciliaris* is restricted to the northernmost counties with the exception of one county in the extreme south (Homoya 1991). It grows in bogs and moist sand flats. In the latter habitats, typically, only a few plants are present, whereas in bogs, it may be plentiful (Homoya 1991). Associated species in Indiana bogs are *Chamaedaphne calyculata, Cypripedium acaule, Osmunda cinnamomea, O. regalis, Rhynchospora alba, Sarracenia purpurea,* and *Vaccinium oxycoccus* (Homoya 1991). Sheviak (1974) notes an interesting distribution pattern in Illinois. It is reported from only three counties: Union in southwest Illinois and Cook and Kanakee Counties in the northeastern part of the state. Sheviak considers these as two separate prongs of the westward migration of the plant, the pattern of which may be due to climactic factors. Cook and Kanakee Counties benefit from the moderating effect of proximity to the Great Lakes and from winter snow cover. Lack of these factors in westerly northern counties may be preventing further migration westward, even though suitable habitat conditions exist elsewhere in northern Illinois. Where *P. ciliaris* occurs in Illinois, associated species include: *Salix glaucophylloides, Vaccinium angustifolium* var. *laevifolium, Osmunda cinnamomea, O. regalis, Pteridium aquilinum, Liparis loeselii, Andropogon gerardii, Liatris spicata, Pedicularis canadensis, Rudbeckia hirta,* and *Spartina pectinata* (Sheviak 1974).

THREATS TO TAXON

In New England, a total of thirty-one former populations of *Platanthera ciliaris* have either disappeared or not been relocated and a number of the extant populations appear to be declining. Causes for the plant's scarcity are likely due to external factors such as natural succession, changes in land use, picking of the attractive flowers, collecting, damage to plants from animals or late spring frost, and changes in hydrology. There may also be other factors such as reproductive limitations, lack of mycorrhizal fungi, or special requirements, as yet unknown. For the New England populations, a number of potential threats that may be affecting the different occurrences have been identified. These are discussed below in order of perceived importance.

Shading by Growth of Woody Species

Platanthera ciliaris is primarily a plant of sunny, open places, although it will tolerate light shade. Only within the Blue Ridge of North Carolina is it reported to grow in full shade (Case 1987). Because the taxon is at the northern limit of its range, it is less tolerant of marginal conditions, including shade, in New England than it is in more southerly locations. At many New England sites, specifically MA .003 (Westwood), RI .002 (Hopkinton), RI .004 (Kingston), CT .007 (Old Saybrook) and CT .011 (Montville), shade resulting from the overgrowth of woody species is cited as a reason for the apparent loss of each population. Shade is also mentioned as a factor in the observed population declines at CT .002 (East Lyme) and CT .009 (Montville). During the 19th century, when many of the now lost populations were first discovered, open land was more common. As the landscape reverted to forest cover, much of the potential habitat for *P. ciliaris* likely disappeared.

Loss of Habitat

The loss of habitat through development, conversion to agriculture, road construction and the like have undoubtedly contributed to the demise of *Platanthera ciliaris* populations in New England. This phenomenon was remarked upon by Keenan (1998) who noted the loss of populations in Connecticut and Long Island. He comments that in 1940, Roy Latham reported that the species was abundant in western Long Island and rare at the eastern end. Today, Keenan (1998: 186) reports a "handful" of sites, all at the eastern end. Keenan (1998: 185-186) also quotes Mabel Osgood Wright in 1901 describing a field in Connecticut as follows: "Each summer two acres in extent are literally overwhelmed and drenched with the splendid color of this barbaric orange flower. Yet its haunt has already been encroached upon by the onion raiser and small farmer who, with growing intelligence, finds the deep rich soil well worth redeeming until, I fear, another half dozen years will see this flower driven to a few uncultivable borders." Whiting and Catling (1986) consider destruction of natural habitat to be responsible for the most serious depletion of native orchids. With specific reference to *P. ciliaris*, Brown (1997: 136) states that succession and loss of habitat has greatly reduced the number of sites for this species in the northeastern United States. In Massachusetts, several historical sites have been altered by development (Sorrie 1987). The region has also lost many wetlands and it is only in recent decades that wetland protection has been implemented.

It is important to note that some forms of habitat disturbance almost certainly benefit *Platanthera ciliaris*. A number of authors point out the fact that *P. ciliaris* is frequently found in disturbed habitats such as roadside ditches (Morris and Eames 1929, Case 1964, Sheviak 1990). Sand excavation, ditch clearing, minor draining or flooding activities that create wet, exposed, thinly vegetated sandy soils may provide suitable habitat for colonization by *P. ciliaris*. At least two of the extant New England sites, RI .014 (Charlestown) and CT .002 (East Lyme) have undergone disturbance activities that appear to have been favorable to *P. ciliaris*. Burning is also potentially beneficial to

populations of *P. ciliaris*. During the spring of 2003, controlled burning, preceded the previous year by brush clearing, was done at RI .014 (Charlestown). Early results indicate that the cutting and burning resulted in increased numbers for *P. ciliaris*. Speculation regarding the plant's frequent occurrence along rail lines is that the fires that often occurred along the tracks favored the growth of the orchid (Morris and Eames 1929).

Water Table Fluctuation

Water table fluctuation has occurred at CT .007 (Old Saybrook), due in part to nearby mining of sand and gravel. This lowering of the water table may be one cause for the loss of *Platanthera ciliaris* at this site. A search for the occurrence in 2003 revealed that the once wet area has become excessively dry (Sharp, personal observation). Although several researchers note that *P. ciliaris* can tolerate a range of conditions, most New England populations either are or were located in moist areas with the water table near the surface, at least for part of the year. All of the extant Connecticut populations occur within hydric soils that are poorly drained or somewhat poorly drained. Killingbeck et al. (1998) report significantly higher soil moisture within the core area for the *P. ciliaris* population at RI .014 (Charlestown) as contrasted to the surrounding area, although they did not consider soil moisture to be a limiting factor. Too much water may also be problematical; *Platanthera* populations inundated by floodwaters have been destroyed (Case 1987). Raised water tables, if temporary, could have the beneficial effect of destroying competing vegetation and creating an environment for *P. ciliaris* once the waters recede. It appears that either too much or too little water may be detrimental in the short term.

Picking of the Attractive Flowers and Collection for Gardens

At CT .002 (East Lyme), a picked flower placed in a soda bottle was once observed at the farm stand (Hartford *Courant* 1981). Sexton (undated) cites collecting, picking and trampling as major threats to the orchid populations in Connecticut and Botanist William Moorhead (in a Connecticut EOR) identifies picking of flowers as a possible cause for the disappearance of *Platanthera ciliaris* from CT .004 (Voluntown). The population was along the roadside close to a busy campground. Picking may also be a problem at CT .009, another population close to a road that is frequented by walkers and joggers (William Moorhead, personal communication). Stuckey (1967) mentions that *P. ciliaris,* along with its close relative *P. blephariglottis,* was once so abundant in wet meadows that it was cut for flower arrangements in summer hotels in Watch Hill, Rhode Island. Although most knowledgeable botanists would not pick them, these orchids remain vulnerable to picking by those ignorant of their rarity. Whiting and Catling (1986) state that one of the greatest threats to native orchids results from collecting them for the garden. Information regarding *Platanthera ciliaris* populations available on orchid web sites may also attract orchid fanciers with the end result of picked and/or collected plants.

Invasive Species

Invasive species must be considered as at least a potential threat, as these non-native plants are becoming widespread throughout New England. At CT .002 (East Lyme), *Eleagnus umbellata* is beginning to invade the edges of the field and at RI .005 (South Kingstown) invasive species have been cited in Element Occurrence Records as a threat to the occurrence. Although not present within the core habitat at RI .014 (Charlestown), *Eleagnus umbellata* and *Rosa multiflora* occur within the nearby habitats (Sharp, personal observation) and could begin to encroach upon the population if not held in check. Because invasive plants are aggressive competitors, they pose the potential threat of spreading quickly and shading out *P. ciliaris.* Some invasive species may also draw insect pollinators away from *P. ciliaris*, thus competing for pollinators in addition to other plant resources.

Herbivory

In Rhode Island, Stuckey (1967) reports that rabbits and deer eat orchids, and documents the predation of *Platanthera blephariglottis* by rabbits. William Moorhead (personal communication) observed flowers bitten off at CT .007 (Old Saybrook) and CT .002 (East Lyme). At RI .014 (Charlestown), deer have been known to eat some of the *P. ciliaris* flowers but appear not to be a significant threat at this time (Rhode Island EOR; Rick Enser, personal communication). Deer browse has also been observed at CT .005 (Old Saybrook) and CT .007 (Old Saybrook) (Connecticut EOR). Deer populations in Southern New England continue to increase and this may be a factor for concern. However, no direct observations regarding deer predation on the other populations have been documented.

Case (1987) observed extensive damage to the roots and over-wintering buds of *Platanthera ciliaris* in a Michigan bog. Apparently, rodents, most likely voles, found these fleshy parts to be tasty and damage to the population was significant. In New England populations, rodent damage has never been cited; however, this may be due to lack of research into this potential problem.

Trampling and Compaction of Soil

Because of the attractive nature of these orchids, they are likely to be visited by botanists and orchid fanciers. In fact, in 2003, a web site posting provided directions to RI .014 (Charlestown) and drew at least one unauthorized visitor to the site (Enser, personal communication). At that site and at CT .002 (East Lyme) and CT .006 (Deep River), it is difficult to view the orchids without trampling plants, particularly the less noticeable vegetative plants. Trampling the plants and their habitat could result in soil compaction, damage to the plant buds, and damage to the shoot. This could have negative impacts for future plant growth.

Late Spring Frost

A late spring frost can be damaging to populations of *Platanthera ciliaris*. Many plants of *P. ciliaris* fail to bloom if subjected to a late frost (Case 1987). This, in turn, lowers seed production and may result in lower production the following year. Sheviak (1974) also mentions a late frost as potentially damaging to *P. ciliaris* populations.

Disease

As indicated previously, *Platanthera ciliaris* may suffer from fungal attack of the leaves. Case (1964) refers to a "blackening disease," which causes the orchid leaves to turn black and wither. There is no mention of the blackening disease in any of the field forms or reports for New England populations. Nevertheless, fungal attack is a potential threat and should it occur, could severely impact New England's few remaining populations.

Reduction in Pollinators

Due to the fact that fruit set in *Platanthera ciliaris* can be pollinator-limited, severe reduction in pollinators could negatively impact the reproductive success of the species. As documented by research, the principle pollinators of *P. ciliaris* are butterflies and the spicebush swallowtail (*Papilio troilus*) appears to be the most frequently observed pollinator (Smith and Snow 1976). A crash in butterfly populations could prove harmful to the orchid.

DISTRIBUTION AND STATUS

General Status

Platanthera ciliaris ranges from southern New England west to southern Ontario (historic), southern Michigan, Illinois south along the coastal plain to Florida, and west to Texas, Oklahoma and Missouri (Fernald 1950, Case 1987, Crow and Hellquist 2000; Table 1, Figure 1). It is ranked as G5, meaning that it is a globally secure species and in the United States is ranked as N5, nationally secure (NatureServe 2003). Herbarium specimens indicate that *P. ciliaris* was present in Ontario in Essex County near Leamington prior to 1901, but the species is now believed to be extinct in Ontario (Whiting and Catling 1986, Oldham 1996).

Status in New England

Platanthera ciliaris is mentioned in some botanical manuals and by the USDA Plants National Data Base (USDA, NRCS 2003) and NatureServe (2003) as occurring in Vermont with a rank of SR (Reported); however, it is not a species tracked by the Nongame and Natural Heritage Program, Vermont Department of Fish and Wildlife (Robert Popp, Vermont Nongame and Natural Heritage Program, personal communication). Seymour (1969) does not include *P. ciliaris* as a part of the Vermont flora, although it is listed in the Vermont Bird and Botanical Club 1973 checklist as occurring in Orleans County (Popp, personal communication). There is a specimen at the Pringle Herbarium at the University of Vermont, but no mention of such a specimen is included in Arthur Haines' review of herbaria specimens (Haines, unpublished data). Jenkins and Zika in their 1991 checklist mention the species as being deleted from the flora because the specimen is of doubtful provenance (Popp, personal communication). It is probable that the specimen is correctly identified, but was not actually collected in Vermont.

In New Hampshire, where it is listed by NatureServe (2003) as SX, *Platanthera ciliaris* is currently in the database as a tracked species; however, there are no occurrences in the database. The New Hampshire Natural Heritage Bureau is nearing the completion of an extensive review of the list of tracked species, which resulted in a recommendation that *P. ciliaris* be dropped from the tracking list (Sara Cairns, New Hampshire Natural Heritage Bureau/DRED, personal communication). In Arthur Haines' review of herbaria specimens his comment on the sole specimen reported from New Hampshire (collected by H. Jesup in 1872, labeled with Hanover NH) is as follows: "Label data is highly suspect. Location and date were, however, penned in by collector. Probably represents location of herbarium (the Jesup Herbarium at Dartmouth) rather than location of collection" (Haines, unpublished data). In short, the evidence of the plant ever having been found in New Hampshire is dubious (Cairns, personal communication). *Platanthera ciliaris* is not ranked by *Flora Conservanda* in either Vermont or New Hampshire.

Table 1. Occurrence and status of *Platanthera ciliaris* in the United States and Canada based on information from Natural Heritage Programs and USDA, NRCS 2003.

OCCURS & LISTED (AS S1, S2, OR T &E)	OCCURS & NOT LISTED (AS S1, S2, OR T & E)	OCCURRENCE REPORTED OR UNVERIFIED	HISTORIC (LIKELY EXTIRPATED)
Connecticut (S1, S2, T): 8 extant and 9 historic occurrences in 4 counties	Kentucky (S?)	Alabama (SR)	Delaware (SH)
Illinois (S1, E): 2 counties	North Carolina (S4): 43 counties	Arkansas (SR): 21 counties.	District of Columbia (SH)
Indiana (S1, E)	Virginia (S3S4): 47 counties	Florida (SR, T): 38 counties	Massachusetts (SX, H): 10 historic occurrences in 4 counties
Maryland (S2, T)	West Virginia (S?): 20 counties	Georgia (SR): 36 counties	New Hampshire (SX): dubious record
Michigan (S2, T): 15 counties		Louisiana (SR)	Ontario (SX) believed extirpated in Ontario
Missouri (S1): 3 counties		Mississippi (SR)	
New Jersey (S2)		South Carolina (SR): 15 counties	
New York (S1, E): 14 counties		Tennessee (SR): 30 counties	
Ohio (S2, T)		Vermont (SR)	
Oklahoma (S1)			
Pennsylvania (S2, T)			
Rhode Island (S1, E): 2 extant and 12 historic occurrences reported from 3 counties			

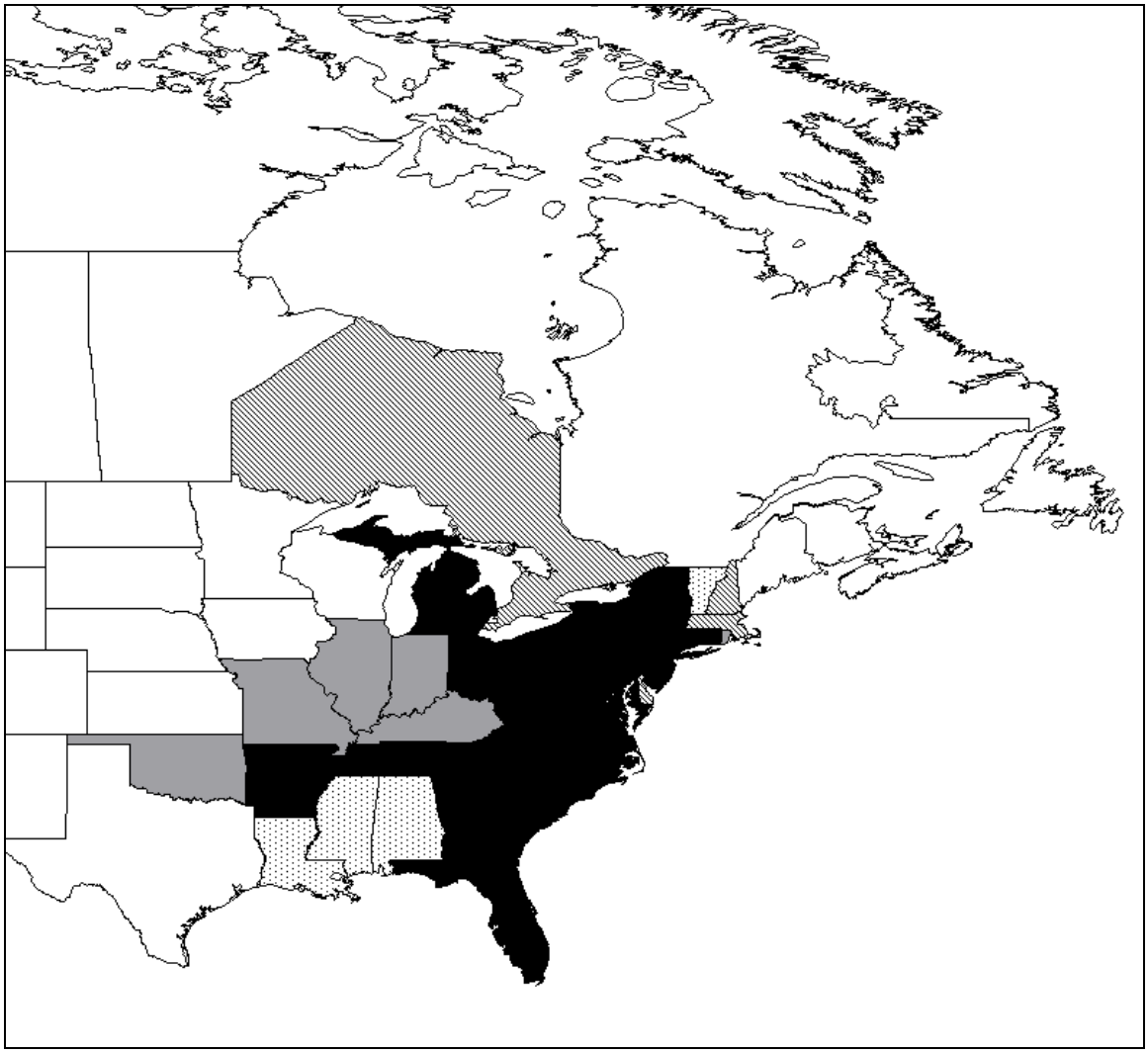

Figure 1. Occurrences of *Platanthera ciliaris* in North America. States and provinces shaded in gray have one to five current occurrences of the taxon. Areas shaded in black have more than five confirmed occurrences. States and provinces with diagonal hatching are designated “historic” or “presumed extirpated,” where the taxon no longer occurs. States with stippling are ranked “SR” (status "reported" but not necessarily verified). See Appendix for explanation of state ranks.

Status of All New England Occurrences — Current and Historical

Platanthera ciliaris is considered extant at ten sites in New England: two in Rhode Island and eight in Connecticut. However, three of the Connecticut populations have not been seen — despite searches — for at least ten years, and are thus ranked F ("Failed to find") by the state. Another two Connecticut populations have not been observed since 1987 and 1997, respectively. The species is recorded from 31 additional historic populations in Massachusetts, Rhode Island, and Connecticut.

The status of all New England occurrences of *Platanthera ciliaris* is summarized below in Table 2, and Figures 2 and 3 show the distribution of extant and historic occurrences, respectively.

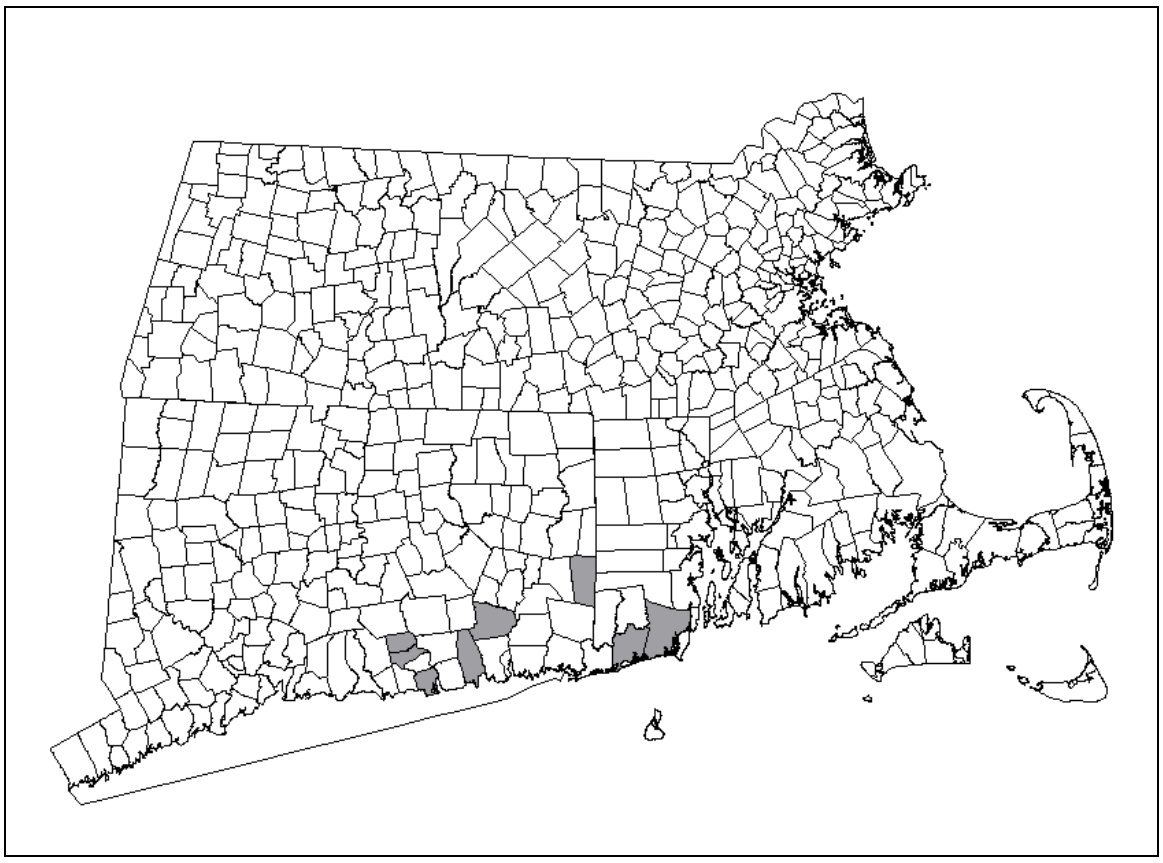

Figure 2. Extant occurrences of *Platanthera ciliaris* in New England. Town boundaries for southern New England states are shown. Towns shaded in gray have one to five confirmed, extant occurrences of the taxon.

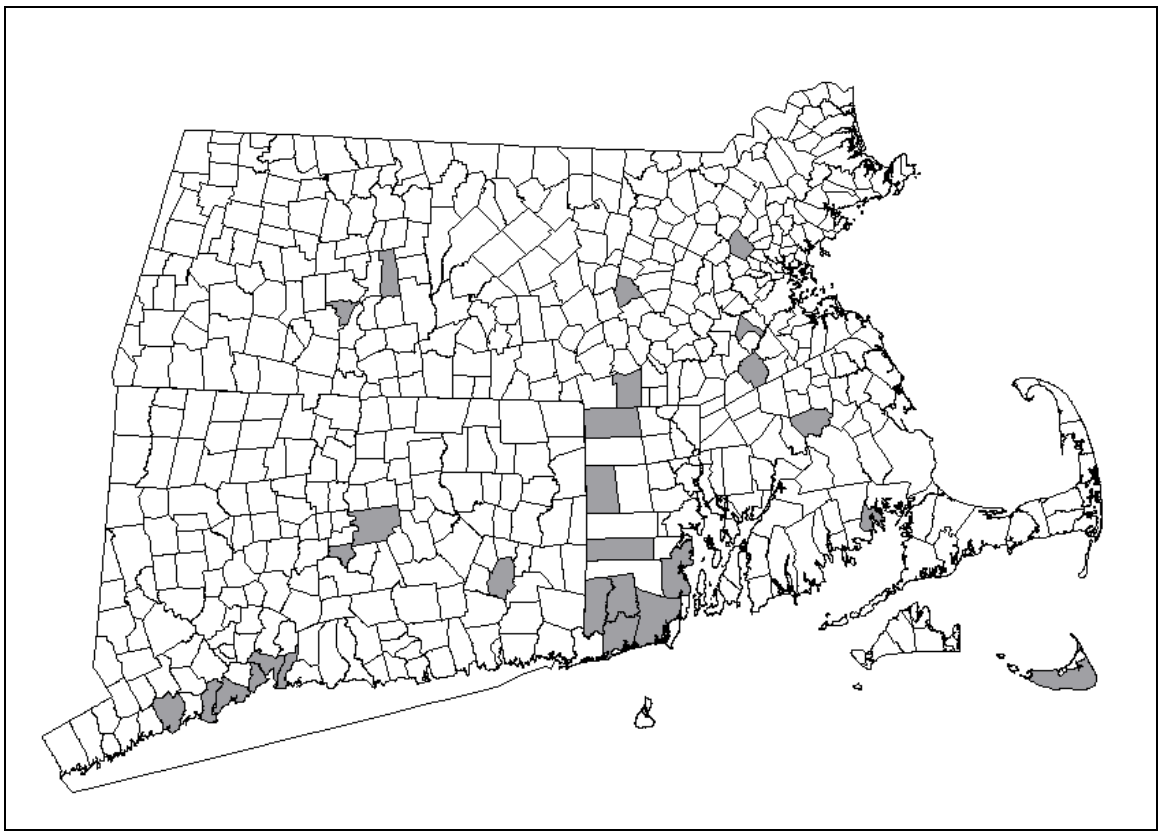

Figure 3. Historic occurrences of *Platanthera ciliaris* in New England. Towns shaded in gray have one to five historic records of the taxon.

Table 2. New England Occurrence Records for *Platanthera ciliaris.* Shaded occurrences are considered extant.			
State	**EO #**	**County**	**Town**
MA	.001	Plymouth	Bridgewater
MA	.002	Nantucket	Nantucket
MA	.003	Norfolk	Westwood
MA	.004	Plymouth	Marion
MA	.005	Hampshire	Amherst
MA	.006	Hampshire	Easthampton
MA	.007	Middlesex	Lexington
MA	.008	Norfolk	Sharon
MA	.009	Worcester	Uxbridge
MA	.010	Worcester	Northborough
RI	.001	Providence	Burrillville
RI	.002	Washington	Hopkinton
RI	.003	Washington	South Kingstown
RI	.004	Washington	Kingston
RI	**.005**	**Washington**	**South Kingstown**
RI	.006	Washington	Charlestown
RI	.007	Kent	West Greenwich
RI	.008	Providence	Burrillville
RI	.009	Providence	Foster
RI	.010	Washington	Hopkinton
RI	.011	Washington	Richmond
RI	.012	Washington	South Kingstown
RI	.013	Washington	South Kingstown
RI	**.014**	**Washington**	**Charlestown**
CT	.001	Fairfield	Stratford
CT	**.002**	**New London**	**East Lyme**
CT	**.003**	**Middlesex**	**Chester**
CT	**.004**	**New London**	**Voluntown**
CT	**.005**	**Middlesex**	**Old Saybrook**
CT	**.006**	**Middlesex**	**Deep River**
CT	**.007**	**Middlesex**	**Old Saybrook**
CT	.008	New London	Norwich
CT	**.009**	**New London**	**Montville**
CT	.010	Middlesex	Cromwell
CT	**.011**	**New London**	**Montville**
CT	.012	Hartford	Glastonbury
CT	.013	Fairfield	Fairfield
CT	.014	New Haven	East Haven
CT	.015	New Haven	Milford
CT	.016	New Haven	New Haven
CT	.017	New Haven	West Haven

II. CONSERVATION

CONSERVATION OBJECTIVES FOR THE TAXON IN NEW ENGLAND

Platanthera ciliaris is a regionally rare, Division 2 species in New England (Brumback and Mehrhoff et al. 1996). Globally, the species is ranked G5 and is considered to be secure. In New England, twenty-seven sites documented by state Natural Heritage programs are considered historic, three are ranked as extirpated, and one is unranked. Of the ten New England sites still officially considered extant, two have remained relatively stable, two have recently shown decline and six have not been found in recent surveys.

The primary 20-year conservation objectives in New England for *Platanthera ciliaris* are to protect and/or restore vigor to existing populations and to maintain a minimum of fourteen occurrences in Massachusetts, Rhode Island and Connecticut. This latter objective does not approach the historic levels of *P. ciliaris* in New England, but will ensure its continued presence as an element of the New England flora. Because of the loss of habitat and the requirement to manage existing habitats by staving off natural succession, it may be impractical to endeavor restoration of the taxon to its historic population levels within the next 20 years; however, this objective should be revisited if the occurrence goal is reached before then. The number fourteen has been selected because there are ten known sites for which management or rediscovery may be possible, although in some instances the possibility is remote. There is also suitable habitat available in southern New England, allowing for the possibility of new discoveries of *P. ciliaris*. The number is also based upon the author's opinion of what constitutes a realistic goal, particularly since each site will require ongoing management. It is envisioned that this objective will be fulfilled primarily through discoveries from record-based searches and through *de novo* searches in disturbed habitats such as power line rights-of-way, logged areas, and gravel pits. The relatively recent find of the large population in Rhode Island during the summer of 1993 indicates that future discoveries are possible. Suitable habitats for rediscovery of *P. ciliaris* are available in southern New England, as are opportunities for management at extant and some of the recently lost sites. Populations within the fourteen occurrences should be maintained at a minimum of 50 to 250 stems for sustainability. This number is based upon the numbers in the generalized estimates of minimum viable population sizes for herbaceous perennial species (Falk et al. 1996).

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IV. APPENDICES

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1. **Unpublished Data References**

2. **Additional References Useful in Preparation of the Conservation Plan**

3. **An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe**

1. Unpublished Data References

Haines, Arthur
Herbarium Recovery Project
New England Wild Flower Society
180 Hemenway Road
Framingham, MA 01701

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3. An Explanation of Conservation Ranks Used by The Nature Conservancy and NatureServe

The conservation rank of an element known or assumed to exist within a jurisdiction is designated by a whole number from 1 to 5, preceded by a G (Global), N (National), or S (Subnational) as appropriate. The numbers have the following meaning:

1 = critically imperiled
2 = imperiled
3 = vulnerable to extirpation or extinction
4 = apparently secure
5 = demonstrably widespread, abundant, and secure.

G1, for example, indicates critical imperilment on a range-wide basis -- that is, a great risk of extinction. S1 indicates critical imperilment within a particular state, province, or other subnational jurisdiction -- i.e., a great risk of extirpation of the element from that subnation, regardless of its status elsewhere. Species known in an area only from historical records are ranked as either H (possibly extirpated/possibly extinct) or X (presumed extirpated/presumed extinct). Certain other codes, rank variants, and qualifiers are also allowed in order to add information about the element or indicate uncertainty.

Elements that are imperiled or vulnerable everywhere they occur will have a global rank of G1, G2, or G3 and equally high or higher national and subnational ranks (the lower the number, the "higher" the rank, and therefore the conservation priority). On the other hand, it is possible for an element to be rarer or more vulnerable in a given nation or subnation than it is range-wide. In that case, it might be ranked N1, N2, or N3, or S1, S2, or S3 even though its global rank is G4 or G5. The three levels of the ranking system give a more complete picture of the conservation status of a species or community than either a range-wide or local rank by itself. They also make it easier to set appropriate conservation priorities in different places and at different geographic levels. In an effort to balance global and local conservation concerns, global as well as national and subnational (provincial or state) ranks are used to select the elements that should receive priority for research and conservation in a jurisdiction.

Use of standard ranking criteria and definitions makes Natural Heritage ranks comparable across element groups; thus, G1 has the same basic meaning whether applied to a salamander, a moss, or a forest community. Standardization also makes ranks comparable across jurisdictions, which in turn allows scientists to use the national and subnational ranks assigned by local data centers to determine and refine or reaffirm global ranks.

Ranking is a qualitative process: it takes into account several factors, including total number, range, and condition of element occurrences, population size, range extent and area of occupancy, short- and long-term trends in the foregoing factors, threats, environmental specificity, and fragility. These factors function as guidelines rather than arithmetic rules, and the relative weight given to the factors may differ among taxa. In some states, the taxon may receive a rank of SR (where the element is reported but has not yet been reviewed locally) or SRF (where a false, erroneous report exists and persists in the literature). A rank of S? denotes an uncertain or inexact numeric rank for the taxon at the state level.

Within states, individual occurrences of a taxon are sometimes assigned element occurrence ranks. Element occurrence (EO) ranks, which are an average of four separate evaluations of quality (size and productivity), condition, viability, and defensibility, are included in site descriptions to provide a general indication of site quality. Ranks range from: A (excellent) to D (poor); a rank of E is provided for element occurrences that are extant, but for which information is inadequate to provide a qualitative score. An EO rank of H is provided for sites for which no observations have made for more than 20 years. An X rank is utilized for sites that are known to be extirpated. Not all EOs have received such ranks in all states, and ranks are not necessarily consistent among states as yet.